Investigation of the Richtmyer-Meshkov instability

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Riccardo Bonazza, Mark Anderson and Jason Oakley

Department of Engineering Physics
University of Wisconsin - Madison

Technical report for the period April 2006 - April 2007

1 Introduction

The present research program is centered on the experimental and numerical study of the hydrodynamics of shock-accelerated spherical density inhomogeneities. These flows are part of a broader category of shock-induced mixing flows that play a critical role in the implosion of D-T pellets in laser-driven ICF experiments.

The value of our work is both in the physics that can be learned from our experiments and calculations and in the validation that comes from comparing the experiments with the numerical results.

2 Accomplishments

In the past year, complete experimental series have been carried out to study the response of a helium bubble rising freely in an argon atmosphere to acceleration by a planar shock of strength $1.2 \leq M \leq 3.3$; and preliminary experiments have been performed on sulfurhexafluoride and refrigerant 12 (R12) bubbles falling freely in a nitrogen environment.

In parallel to the experiments, calculations have been performed using the *Raptor* code and the uBGL computer, both made available by Lawrence Livermore National Laboratory. The calculations have covered essentially the same parameter space as the experiments.

The papers "Experimental Study of the Interaction of a Planar Shock with a Free-Rising Bubble" and "A Computational Parameter Study for Shock-Bubble Interactions in 3D, with and without Modeled Soap Film", presented at the 10th International Workshop on the Physics of Compressible Turbulent Mixing in Paris, France, in July 2006 are included here as a summary of our progress.

3 Work for the current year of funding

Experiments and calculations will continue to complete the study of the SF_6 and R12 bubbles. Two graduate students are expected to complete their work and graduate by December 2007; two new graduate students will be recruited.

4 Publications and presentations

Our work was presented at the 10th International Workshop on the Physics of Compressible Turbulent Mixing (Paris, France, July 2006) and at the 59th Annual Meeting of the APS Division of Fluid Dynamics Tampa, FL, November 2006).

An article was published:

Ranjan D., Niederhaus J., Motl B., Anderson M., Oakley J., Bonazza R., Experimental Investigation of Primary and Secondary Features in High-Mach-Number Shock-Bubble Interaction *Phys. Rev. Lett.* **98**, 024502, 2007

One more manuscript is nearing submission to the Journal of Fluid Mechanics.

5 Personnel

Faculty and staff involved in and supported by the program include:

Prof. Riccardo Bonazza, Associate Professor, Dept. Engineering Physics; supported for 1 summer month

Dr. Mark Anderson, Associate Scientist, Dept. Engineering Physics; supported for 1 month

Dr. Jason Oakley, Assistant Scientist, Dept. Engineering Physics; supported for 8 months

Mr. Paul Brooks, Instrumentation Specialist, Dept. Engineering Physics; supported for 0.8 month

Graduate students supported by and fully involved in the program in the past year include:

Mr. Brad Motl (USA; pursuing a PH.D. degree); supported for 8 months

Mr. John Niederhaus (USA; pursuing a Ph.D. degree); supported for 2 months

Mr. Devesh Ranjan (India; pursuing a Ph.D. degree); supported for 8 months

Mr. Jeremy White (USA; pursuing a Ph.D. degree); supported for 8 months

About 3 **undergraduate students** were also involved in and supported by the program at various levels and for different lengths of time.